PSB PENNSYLVANIA SOYBEAN BOARD Progress Powered by U.S. Farmers | PennState Extension

CHECKPOINT

The soy checkoff's mission is to maximize profit opportunities for soybean farmers. That starts in the field with checkoff-funded research.

Another Exciting Year in Store for the Pennsylvania On-Farm Network

Heidi Reed, Extension Agronomy Educator, Penn State

As soybean producers throughout Pennsylvania begin planting their 2020 crop, a group of growers are also participating in research projects through the On-Farm Network. For the eleventh year, Penn State Extension will continue this important soybean research. Funded by the Pennsylvania Soybean Board, the series of on-farm trials focuses on management practices to improve soybean profitability and sustainability for Pennsylvania producers.

The On-Farm Network takes soybean research studies out of the lab and small test plots into the fields of soybean growers. The Network works by testing practices in real-world conditions on plots planted by farmer/collaborators throughout Pennsylvania on their own farms with their own equipment. Last year, research and monitoring plots were conducted in 27 counties throughout the state to test practices in a variety of environments at production scale.

Recently there has been a concerted effort to establish more trials in northern and western Pennsylvania, which has a shorter history of growing soybeans and several management challenges unique to their geography.

ON-FARM NETWORK RESEARCH CONTINUED FOR 2020

Slug monitoring: Slugs are an economically important pest, but their biology and behavior is not well understood. Slug populations and damage to crops will be recorded.

Good inoculation practices: Soybean performance starts at the seed. The impact of including multiple bacteria species plus micronutrient inoculum will be measured.

Seed treatment: Though extensively used in Pennsylvania, fungicide seed treatment-associated positive yield responses are variable in soybean. The effect of seed treatment on yield will be evaluated.

Look for this sign in soybean fields throughout Pennsylvania that are participating in the On-Farm Network research.

Yield limiting factors: Microbial communities in high- and low-yielding environments and their influence on yield are unclear. Soil and root samples will be analyzed at different growth stages and microbial communities will be described.

Deep ripping: Deep tillage, ripping, or subsoiling compacted soil may or may not affect soybean yield in subsequent growing seasons. The effect of deep ripping on soybean performance will be evaluated, especially on shale-type soils.

NEW ON-FARM RESEARCH FOR 2020

Expanding cover crop options: Cover crop options after soybeans are limited. The viability of broadcast seeding various cover crops into standing soybeans as an establishment method will be assessed.

Learn more

For the results of past studies from the On-Farm Network, go the Pennsylvania Soybean Board website at **www.pasoybean.org.** During the growing season, updates will be available through the Field Crop News from Penn State Extension.If you're interested in joining the On-Farm Network trial as a farmer/cooperator, contact your local Penn State Extension Agronomy Educator.

Deep Ripping to Alleviate Soil Compaction in Soybeans

Andrew Frankenfield, Senior Extension Agronomy Educator, Penn State

Long term no-till and the use of cover crops has significantly reduced soil erosion on Pennsylvania farms over the past decade or more. Many Pennsylvania fields receive traffic from heavy farm equipment at times when the soil moisture is less than ideal and create wheel tracks or ruts.

As farmers have improved their soil health with no-till and cover crops they are hesitant to go back to tillage to alleviate compaction and simply want to just level the soil surface to smooth out any ruts and let nature take care of the rest.

There are tools like the Soil Penetrometer to test the density of the soil profile, but some argue that it is not an accurate reading since small roots and earthworm channels do not follow a straight line into the soil profile as the testing probe does. So how well are those cover crops performing? Which brings us to deep ripping. The theory is to use a no-till subsoiler when the soil is dry enough to make a slit below the hard pan and allow water and roots to penetrate greater depths.

In the spring of 2019 Penn State Extension used a no-till deep ripper on a plot at the Southeastern Agricultural Research and Extension Center farm in Lancaster County. Due to the challenging wet spring and early summer we didn't get the plot ripped and planted to soybeans until late May. In the second part of the study, we ripped and planted soybeans in early July to simulate deep ripping after wheat, when the ground would typically be dryer. The results from the 2019 plots showed no yield response to deep ripping over the control of not ripping.

Plans for 2020 include repeating the study at the research farm and following the 2019 ripped plots as they are planted to corn. We also intend to deep rip a few additional plots on soils that are shale and those with the tendency to have a fragipan. Stay tuned for a summer field day in Montgomery County on August 26.

Harvesting soybean plots in October 2019 at the Southeastern Agricultural Research and Extension Center in Manheim, Pa.

Photo: Dwane Miller

Research Results at Your Fingertips

The United Soybean Board's National Soybean Research Database website is designed for farmers to read about the benefits of research they spend checkoff dollars on in their states. Read articles and summaries about research projects and see up-close information about soybean diseases and pests. You'll also find the latest publications and resources and can see what's new in soybean research.

The database is searchable by state, year and category at **www.soybeanresearchdata.com**.

Fungicide Seed Treatments: A Worthwhile Investment?

Ananda Bandara, Dilooshi Weerasooriya, Paul Esker
Dept. of Plant Pathology & Environmental Microbiology, Penn State

Use of fungicide seed treatments has become a routine practice among the nation's soybean growers, including those in Pennsylvania. Fungicide treatments can protect the seeds and seedlings from various diseases such as root rots and damping off, caused by soilborne pathogens such as *Pythium, Phytophthora, Fusarium and Rhizoctonia.*

Farmers typically use seed-applied fungicides with the intention of ensuring maximum crop establishment and plant stands. Research from around the nation, however, has been unable to demonstrate the usefulness of seed-applied fungicides in a consistent manner. Seed-applied fungicides may not result in extra economic advantage due to various reasons. There might not be sufficient disease pressure in the soil at the time of planting to manifest the diseases. So, the question becomes, is it worth investing in a fungicide seed treatment as a routine practice?

In 2018, we conducted on-farm field and small plot trials in seven Pennsylvania counties (Bradford, Armstrong, Lancaster, McKean, Centre, Somerset and Tioga) to evaluate the impact of Apron Maxx seed treatment on root rot incidence, seedling vigor traits (seedling height, tap root length, root/shoot weight), plant stand, test weight (lbs./bu.), and yield (bu./ac.). We did not observe a significant difference between control and seed treatment for vigor-related traits and plant stand at all locations. Seed treatment also did not significantly increase test weight or yield compared to control at all locations.

Under the trial conditions during that year, our study showed that Apron Maxx was unable to confer an economic benefit to the growers. We are continuing to analyze the data from trials in 2019 and will report new findings shortly.

Given the results of our research, we recommend that growers use fungicide seed treatments only in situations where fields have disease history and planting is under disease-conducive conditions such as wet and cool soil.

Soybean Good Inoculation Practices

Del Voight, Senior Extension Agronomy Educator, Penn State

In 2018, a group of 14 Penn State Extension staff, agronomists and crop farmers from Pennsylvania toured Brazil to learn about the sustainable high-yielding soybean production and crop management systems of leading Brazilian farms. We learned about the Good Inoculation Practices (GIP) utilized by growers in that country. The Journal of Agronomy details some striking results and explains why Brazilian ag researchers have adopted the technique.

We decided to do our own research on GIP in Southeastern Agricultural Research and Extension Center Pennsylvania. GIP trials at the Southeast Research and Extension Center in 2018 were first planted in a greenhouse environment in sand. We assessed Untreated, Rhizobium, Rhizobium plus Molybdenum, Rhizobium plus Azospirrilium and Rhizobium plus Molybdenum and Azospirriliium. The results suggest a relationship of better nodulation with the combination products.

In 2019, the GIP process included water (3 gpa) as the carrier with Azosprillium and Molybdenum added with liquid rhizobium. This treatment was then compared to water and Rhizobium alone. The Penn State Crop Team had small replicated plots at the Russell E. Larson Research Station in Centre County and the Southeastern Agricultural Research and Extension Center in Lancaster County. Larger plots were then placed with the help of our On-Farm Network growers throughout the state.

While there were no statistically significant differences in the research station plots, there were trends that emerged. At all locations with our on-farm trials, there were greater incidences of higher nodulation. However, this did not translate into a large enough yield increase to be significant. This is often the challenge when completing on-farm research. More replications may prove more reliability in the yield results.

Why is there such variability? One partial answer is the Azospirilium acquired for the 2019 study. When tested at planting time by the Microbiome Lab, it was inconsistent in the level of the organism. In 2020, a more detailed microbiome test will be conducted to ensure that the the levels in the product have enough colony-forming units to be effective. We look forward to additional on-farm testing this year.

Why inoculate?

There are advantages to inoculants and numerous configurations of ingredients that can be applied to seeds. Rhizobia, the soil bacteria in question, form a beneficial relationship with the soybeans to create nodules and fix nitrogen all season long. But sometimes soil might not have enough rhizobia for soybeans. In that case, a soybean inoculant could help add beneficial bacteria back to the soil.

One bushel of soybeans requires 3.5 lbs. of N for a 100-bushel crop. That would be 350 lbs. of N per acre. The nodules fix and supply this demand from the soils if handled properly.

Soils do not contain the rhizobium bacteria specific to soybeans called *Bradyrhizobia japonicum*. The soybean root will send signals out to nearby *Bradyrhizobia japonicum* to trigger and genetically link the two and form a relationship where the plant feeds the bacteria and the bacteria, in turn, turns atmospheric N into usable N for the soybean plant to use for growth.

The nodules are typically formed on the main stem and the fine root hairs from emergence to V2. The process continues but the main infection occurs early and growers can scout at V2- R1 to count for nodules that should be present. If not, perhaps additional N might be responsive.

A properly nodulated soybean plant should have five to seven nodules on the tap root two weeks after emergence or twelve total root nodules per inch of tap root at flowering (R1). Typically, on high yielding fields, I have focused on the main stem and get about 10 large nodules on the main stem at R1.

To evaluate nodule performance, cut nodules in half. Nodules that are actively fixing nitrogen will be colored pink to bright red, while nodules that are white or green are not producing or have not begun to fix N.

Soybean nodulation.

Slug Monitoring in No-Till Fields

Liz Bosak, Extension Agronomy Educator, Penn State

Slugs can be a serious pest in no-till fields during the spring planting season. As crops begin to germinate, slugs will feed on the seedlings and at high populations under favorable weather conditions can eliminate an entire field. Farmers are left with no alternative but to purchase more seed and re-plant the field.

Baited pellets containing a molluscicide can be broadcast to reduce the slug population, but it can be challenging to apply during a rainy spring. The short-term goal of the Pennsylvania Slug Monitoring project is to provide farmers with an in-season weekly report of slug populations across Pennsylvania. In the future, the data will be used to develop a predictive tool or "slug forecast" that farmers can use to improve their management of this pest.

In 2018 and 2019, Penn State Extension Educators in 18 counties monitored slug populations in over 30 field sites. Problem slug fields were identified by the cooperating farmer. Slug traps were placed in each field to monitor juvenile and adult slug species each week before planting. After the crop emerged, crop damage was monitored.

For both seasons, no monitored fields were replanted due to excessive damage by slugs. Crop damage was assessed by looking at each individual plant in 10 row feet and scoring the damage at 0, 25%, 50%, or 75% leaf area removed. The average crop damage for both years never exceeded 25%. Slug populations remained low for both growing seasons.

Again this spring, fields will be monitored for slug populations and crop damage due to slug feeding. Weekly reports during the planting season will be published in Penn State's Field Crop News, an online newsletter. To subscribe to the newsletter, visit **https://extension.psu.edu//email-preferences** and select Agronomic Crops as an interest area.

Marsh slug, the most common species found by the Pa. Slug Monitoring Project in 2018 and 2019.

Photo: Liz Bosak

Mystery of Low Yielding Field Spots

Ananda Bandara, Dilooshi Weerasooriya, Paul Esker, Dept. of Plant Pathology & Environmental Microbiology, Penn State

We all recognize that soybean yield is not spatially consistent. In other words, while certain sites or spots within your farm consistently produce higher yields, other spots within the same field tend to consistently produce lower yields. Over the years, we have identified this spatial yield diversity as a considerable barrier that hinders soybean growers in Pennsylvania from achieving greater per acreage yields.

The underlying causes behind the occurrence of low- and high-yielding field spots remain largely unknown. As a research team, one of the first things that our laboratory at Penn State University wanted to test was whether there was a fertility disparity between high and low yield sites. We also suspected that yield difference between sites can be associated with the soil inhabiting plant parasitic nematodes and soilborne fungal pathogens.

Starting in 2018, we conducted a statewide investigation with the intention of resolving this interesting puzzle. Fourteen farms in 13 Pennsylvania counties (Lancaster, Mercer, Northumberland, Perry, Bedford, Bucks, Lebanon [two farms], Snyder, Butler, Tioga, Centre, Dauphin and Cambria) were chosen for the study. At each farm, we identified historically high and low yield sites with the help of growers.

Working with our Penn State Agronomy Extension Educators, we then sampled bulk soils from five historically high- and low-yielding sites from each farm at early (one trifoliate) and late (at maturity) time points in the growing season. A portion from each soil sample was sent to the nematode assay section of the North Carolina Department of Agriculture & Consumer Services to identify various plant parasitic nematode types present in soil. Assays showed the presence of lesion, stunt, spiral, stubby root, dagger, ring, lance and pin nematodes, with variable numbers depending on the type of nematode. The soybean cyst nematode was however absent in tested samples in 2018.

Another portion from each sample was sent to the agricultural analytical services laboratory at the Pennsylvania State University to assess the soil organic matter, cation exchange capacity, pH, and nutrients (P, K, Mg, Ca, Zn, Cu, S). In our laboratory at Penn State, we quantified the densities of the primary plant pathogenic fungi (*Fusarium, Pythium*, and *Phytophthora* species and *Rhizoctonia solani*) in soil samples. In addition, soil type and slope information for each sampling site were extracted from the United State Department of Agriculture (USDA) Web Soil Survey website.

We finally analyzed the data using appropriate statistical tools. To our surprise, across 14 farms, none of the investigated variables was significantly different between high- and low-yielding sites. At the spatial scale we were studying, the reason behind yield difference between sites was not identified conclusively.

Our next goal was to see whether microorganisms that live in soil and soybean roots represent a piece of the puzzle. Scientists have developed a fascinating DNA-based technology to simultaneously identify thousands of fungal and bacterial species living in substrates like soil or in the human gut without needing to grow them in the lab.

Using this technology, we found that soil from low yield sites contain a higher number of pathogenic fungal species while high yield sites contain a greater number of beneficial fungal species. We further found that roots from high yield sites contain a greater number of plant growth-promoting bacteria.

Our results showed that understanding the soil and soybean root microbial community is a piece of the puzzle to improve our knowledge of yield differences at the site scale within farms. Our findings have opened up a new direction towards the use of site-specific soil management to make soil healthier and production conducive.

Penn State plant pathologists are investigating the underlying causes behind the occurances of low- and high-yielding spots in soybean fields.

Photo: Zach Larson